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INFORMATION REPORT

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COUNTRY USSR(Sverdlovsk Oblast)

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SUBJECT Copper Electrolysis Plant at Verkhnyaya Pyshma

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SUPPLEMENT TO REPORT NO. 25X1X

1. Location:

12 km north of Sverdlovsk at the northern outskirts of Verkhnyaya Pyshma (60°37' E/ 56,55 N), Sverdlovsk Oblast (see Annex 2).

2. Traffic Facilities:

spur track (single track) to the Sverdlovsk-Nizhni-Tagil railroad line. The spur track leads across the plant and ends at a fire clay factory. Wide-gauge sidings lead to the fuel dump and the sulphuric acid tank in the plant itself. The workshop buildings are interconnected by field railroads with British-type (Plymouth) and Soviet-type electric locomotives.

3. Plant History:

Construction of the plant started in 1929 or 1930. According to Soviet press reports production began in August 1934. The construction was scheduled to be completed by 1937. The electrolytic department is a modern plant built on American pattern. It is the largest Soviet electrolytic plant with an annual capacity of 100,000 tons of electrolytic copper. A small smelting plant, a concentration plant and some installations were attached to the electrolytic department in the late thirties. They were scheduled to utilize the nearby copper ore deposits in the Pyshma area. The postwar construction of a new settlement is reported (1946). The construction of a second electrolytic workshop was also allegedly started in the Fall of 1948. According to Soviet press reports projects for the expansion of the plant were under consideration at the time.

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4. plant installations:

a. copper ore production: The Pyshminsk copper occurrences are the most southern deposits of the Kluchevsk-Pyshminsk copper district. The ore (copper ore, pyrites) occurs in several quartz veins. The average copper content is $2\frac{1}{2}$ percent, the maximum content 4 percent. The ore can easily be concentrated. In addition to copper the ore occurrences also contain cobalt and gold in amounts worth mining. The resources are slight and were indicated at 30,000 tons of copper (grade A through C) for the entire Klyuchevsk-Pyshminsk District in 1937. The ore is produced in three mines with a daily capacity of 800 tons (annual capacity 280,000 tons). The annual output was 100,000 tons in 1937.

b. concentration plant: The ore processing capacity is estimated at 800 tons in 24 hours.

(1) The abovementioned installations for the production of black copper from ore are not indicated in any of the available reports covering the period from 1945 to 1949. The mine installations and the concentration plant were possibly a great distance from the plant and therefore were not observed.

(2) Only one source supplied information on the use of the ore. According to his indications the copper ore (designated pyrites by source) was used as admixture for the smelting of crude copper in addition to coke, charcoal and tin. This obviously refers to the occasional production of copper alloys also reported by another source with no further details.

c. copper works: The following installations were recorded:

(1) Refining department:

(a) Installation: Five similar walled reverberatory furnaces with crude oil firing. The crude oil was pumped to the furnace department through a pipe line, 15 cm in diameter. This pipe line was 4 meters above the surface. It entered at the left narrow side of each furnace. The pipe line ended (15 cm within the furnace) in a spray head, 10 cm in diameter.

The furnaces No 1 through 3 were designated "anode furnaces" and served produced anode plates.

The furnaces No 4 and 5 were designated cathode furnaces or "basic furnaces" (due to the "basic" lining). They resmelted cathode plates coming from the electrolysis department and for cast bars and ingots.

At the front part of each furnace were three charging doors (1.5x1.5 meters) with small windows, 30x30 cm. On both sides of each door were connections for the supply of compressed air. Each furnace had a total of six connections. They were joined with the respective compressed air cylinder by a 2 meters long steel pipe continued into a long rubber hose.

Another door for charging was at the right side of the furnace. Each furnace had a smokestack rising 5 to 6 meters above the roofing. According to one source there were also three 30-meter smokestacks in front, in the center and behind the building. Tapping was done at the backside of the furnace.

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above a fire clay canal leading into a casting trough and from there into metal molds placed on rotary stands. Behind the rotary stand was a cooling basin where the molds were chilled immediately after casting. The molds then came to the electrolytic department (furnaces No 1 through 3) or to the planing shop (furnaces No 4 and 5). Field railroad tracks to the raw material depot and the electrolytic department were used for conveying the material. In the workshop itself were two grab crane installations and two rail cranes in front and behind the furnace row.

(b) production: The volumetric capacity of the furnaces is indicated at 160 to 220 tons by four sources

- (1) 220 tons
- (2) Furnaces No 1,2,4 160 tons each
Furnaces No 3,5 200 tons each (in operation since 1946)
- (3) 220 tons
- (4) 200 tons

The melting period lasted for 20 to 24 hours. During this melting operation the furnaces were refilled and tapped three times. The "volumetric capacity" as indicated by sources therefore means the daily output or the daily capacity within 24 hours.

As this operation refers to the refining of concentration material with a copper content of 75 to 80 percent, the furnaces No 1 through 3 would have to daily process 380 to 400 tons of concentration material for the electrolysis. According to one source black copper castings and alloys for manufacturing rings, wire and bars are also produced during one week of each month. Another source confirms the production of alloys. Thus the total daily processing capacity approximates 500 tons for the furnaces No 1 through 3. The following daily capacity figures were indicated by four sources:

- (1) 660 tons
- (3) 520 tons
- (4) 660 tons
- (9) 600 tons

The following measurements of anode plate castings were indicated by five sources:

- (1) 800x800 mm
- (3) 1,000x700 mm
- (3) 1,000x900x30 mm
- (4) 1,000x1,000x30 mm
- (5) 1,200x900x40 mm

A daily amount of about 300 tons delivered by the electrolytic department has to be remelted and cast into molds by furnaces No 4 and 5. Castings rejected in the acceptance control of the planing shop also have to be remelted. The available capacity was apparently more than adequate. The following daily capacity figures were indicated by sources:

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- (1) 440 tons
- (3) 360 tons
- (4) 440 tons
- (2) 400 tons

Bars with a cross section of 16 to 12 square cm. (100 to 150 kg) as well as ingots up to 250 kg were cast. The bars and ingots were shipped to Moscow and Leningrad. Sources described the following melting operation at the furnaces No 1 through 3:

The masonry was removed from the charging doors. The doors were lifted by cranes pulling at the upper-edge handle. The crude copper plates and several beams (fir wood, normal diameter, 5 meters long) were introduced by grab crane. The doors were then walled and the oil supply was opened. Before tapping: opening of the doors, taking out samples. Refilling with additional wood beams. Unscrewing of the compressed air connection. The steel pipe connection of the compressed air supply was then introduced into the molten liquid causing the slag material to be whirled to the surface. According to one source the slag removing operation lasted four hours. It was done four times daily. Ore and tin were used as admixtures in the production of alloys. According to another source the furnaces were used up after three months' operation. They were then pulled down and new furnaces built. According to one source the new furnaces were built ("repairel" as indicated by source) according to the same dimensions.

The use of reverberatory furnaces before the electrolytic process may suggest that the crude ore supplying copper works (Kirovgrad, Alaverdi, Revda;) did not have any converters.

(2) Electrolytic workshop:

It was divided into the following subdepartments:

- (a) Acid department (in the basement): Processing (including diluting) of the acid for the electrolytic baths. The acid was pumped to this department from the sulphuric acid tank through a pipe line 15 cm in diameter and 4 meters above surface.
- (b) Cathode department: Manufacturing of thin electrolytic copper sheets (with two eyes at the upper edge) used as cathodes for the electrolysis.
- (c) Mud department: Drying and pulverization of the anode mud. There was no further processing except for gold production. This dust was shipped in wooden barrels and tin containers (sealed with paraffin). This was obviously the platinic anode and produced during the copper electrolysis in the "SBS" copper works. The mud destined for gold production was channeled directly to the gold washing shop of the plant.
- (d) Electrolytic department:

Installation: electrolytic baths (wooden tubs with lead lining) The indications made by sources on the number and dimension of baths differed greatly.

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number of baths	dimension of one bath
(1): 200 to 300	5x1x1.3 meters
(4): 63 baths in seven rows of nine each	-
(6): 80 baths in two rows of 40 each	8x2.5x2.5 meters
(10): 22 baths	4x2x1.2 meters

There were obviously so many baths that sources could not survey them. Considering the capacity of the plant the number of baths must have ranged between 1,000 to 1,300 depending on the bath voltage. The dimension of one bath may have been 4 to 5x1x1.2 meters.

Different indications were also supplied on the number of anode plates per bath:

- (4): 63 anode plates and 64 cathode sheets
- (3): 31 anode plates

However the figure indicated by source No 3 is more probable considering the length of one bath, the thickness of the anode plate (30 mm) and the 50-mm interval between the anode plate and the cathode sheet. A cathode sheet is at each end of the bath. Each bath therefore consists of 62 elements.

Ceiling crane installations over the baths served for lifting and inserting the plates. All cathode sheets of one bath were suspended at one rod. Therefore they all could be lifted at a time. Production: According to one source the cathode sheets were exchanged every eight days. When removed from the bath they weighed about 50 kg. The anode plates were dissolved three times within eight days.

Another source indicated that the official monthly norm was 8,000 tons of electrolytic copper early in 1948. This norm was regularly filled.

It can be inferred from indications of still another source that the baths were operated at a current varying between 150 and 200 amperes.

(3) Gold washing shop

Though located in the plant area it was especially secured by an extra barbed-wire fence. Anode mud, channeled from the electrolytic department to this shop, was processed. According to one source 70 grams of gold were produced from one ton of raw material.

After processing the mud went to the dump.

(4) Vitriol departments

Installation: Several crystallizers (wooden containers with a 30-mm-lead lining lined in two rows). One source indicated the measurements of these vessels at 6x2x2.5 meters. One 16-m high tower consisting of five superimposed acid tanks, each 3 meters high and 1.8 meters in diameter.

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production:

The acid was pumped from the tanks into the crystallizers. Three latticed iron pipings were suspended in each filled crystallizer. In a process lasting six days the light blue vitriol was deposited in the grid meshes. The vitriol was then shipped off. The vitriol deposited on the bottom and on the walls was of inferior quality. The production of one crystallizer filled four barrels, 130 cm high and 60 cm in diameter. On the average two crystallizers were cleared daily and produced a total of 1½ tons of vitriol which corresponds to the prescribed quota.

(5) Sulphuric acid tower:

It was 10 meters high and 5 meters in diameter. Next to the tower was a pump station pumping the sulphuric acid to the electrolytic department (presumably also to the vitriol departments).

(6) Crude oil bunker:

Although within the plant area it was surrounded by an extra barbed-wire fence. The bunker was built into the ground. Constructed 1946. The volumetric capacity is unknown. Close to the bunker was a pump station pumping the crude oil through a 15 cm pipe line (4 meters above surface) to the reverberatory furnace department and also (according to another source) to the long-distance heating plant.

(7) Planing department:

Installation:

4 planers,
2 "propeller" milling machines
1 plate-shaped milling cutter

Each machine had an electric-motor.

Production:

Planing of ingots and bars coming from the reverberatory furnace department. According to one source the planing department was evacuated at the end of 1948 because it was to be razed.

(8) Locksmith shop:

Installations:

2 planers (US make)
2 lathes
1 horizontal milling machine
1 small milling machine (Soviet make)

Production:

Tin containers for the shipment of pulverized anode mud. The

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filling weight was 50 kg. The electrolytic copper ingots and bars were planed. Machines were repaired.

(9) Carpentry:

Wooden barrels were manufactured for the shipment of pulverized anode mud. The filling weight was 150 kg.

(10) Sawmill:

Installation:

2 multiple blade sawframes.

The sawmill worked for plant requirements.

(11) Fire clay factory:

This factory supplied fireproof material to the reverberatory furnace department.

(12) Long-distance heating plant:

In operation since 1946. It heated the workshops.

(13) Transformer station:

This station transformed the power supplied by the Jugres power plant.

(14) Administration

(15) Laboratory

(16) Plant railroad station with raw material depot

(17) Depot for finished products

(18) Coal dump

(19) Mud dump

(20) Plant fire station

(21) Main guard station

5. power and raw materials:

a. Power was supplied by the Jugres coal-fueled power station, located at the Iset Lake, 10 km to the north. The installed capacity was 250,000 kws.

b. Crude copper was supplied by the Krasnouralsk, Nirovgrad, Revda, Glazverdi and Balkhash copper works.

6. work force and working time

The work force numbered 2,800 men in 1942. Sources indicated the following postwar figures:

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(2)	3,000
(6)	3,000
(8)	3,000
(5)	2,100

Work in the three main departments was done in three 8-hour shifts.

7. Production:

The following monthly production figures were indicated for the beginning of 1949:

Crude copper alloys: about 3,000 tons
electrolytic copper: about 8,000 tons
vitriol (in ingots): about 35 tons (?)
gold: no information is available.

Additional valuable metals produced during the electrolysis were not refined in this plant. The smelting of copper from ore was not recorded.

8. Plant guard:

The plant was surrounded by a wooden fence and watch towers. It was guarded by an armed militia (including women). The gold washing department was additionally guarded by watchdogs. The plant area was illuminated at night by searchlights.

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2 annexes: (1) List of sources
(2) Copper electrolysis Plant in Pyshma,
Sverdlovsk Oblast.

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